

SECTION 6000 - EXCAVATION, TRENCHING AND BACKFILLING (Pipeline Construction)

- 6001 SCOPE. This section covers excavation and trenching work and shall include the necessary clearing, grubbing, and preparation of the site; removal and disposal of all debris; excavation and trenching as required; the handling, storage, transportation, and disposal of all excavated material; all necessary sheeting, shoring, and protection work; preparation of subgrades; pumping and dewatering as necessary or required; protection of adjacent property, backfilling, pipe embedment, surfacing and grading, and other appurtenant work.

Attention is directed to the additional requirements set forth in the General Conditions, Supplemental General Conditions or Special Conditions.

- 6002 GENERAL REQUIREMENTS. Excavation work shall be performed in a safe and proper manner with appropriate precautions being taken against all hazards. Excavations shall provide adequate working space and clearances for the work to be performed therein. In no case shall excavation faces be undercut for extended footings.

Subgrade surfaces shall be clean and free of loose material of any kind when concrete is placed thereon.

Excavations for manholes and similar structures constructed of masonry units shall have such horizontal dimensions that not less than six inches (6") clearance is provided for outside plastering.

Backfilling and construction of fills and embankments during freezing weather shall not be done except by permission of the engineer. No backfill, fill, or embankment materials shall be installed on frozen surfaces, nor shall frozen materials, snow, or ice be placed in any backfill, fill, or embankment.

- 6003 CLASSIFICATION OF EXCAVATED MATERIALS. When specifically indicated in the proposal and contract, classification of excavated materials will be made as follows:

- a. Rock. Rock excavation will be so classified when sandstone, limestone, blue shale or other similar material is encountered and, in the opinion of the engineer, requires drilling or blasting to remove the material.
- b. Earth. All material not classified as rock.

- 6004 CLEARING. The contractor shall do all clearing necessary for access, stringing of pipeline materials, and construction of the pipeline and appurtenant structures.

At the option of the contractor, all trees, underbrush, stumps, roots, and other combustible materials may be stacked and burned on the site at such locations as permitted by the fire marshall and engineer or removed entirely from the site and disposed of at such locations as determined by the contractor. All materials to be burned shall be piled neatly and, when in suitable condition, shall be burned completely. Piling for burning shall be done in such a manner and in such locations as to cause the least fire risk. All burning shall be so thorough that the materials are completely reduced to ashes. Great care shall be taken to prevent the spread of fire beyond the permanent site limits. Fire guards of adequate width shall be provided wherever there is surface vegetation around any brush pile. No burning of trimmings or brush shall be done when the direction or velocity of the wind is such that there would be any danger of fire being carried into adjacent areas. All governmental requirements relative to burning, fire prevention, and air pollution shall be complied with. See Specification Paragraph 1005a.

- 6005 DEWATERING. The contractor shall provide and maintain adequate dewatering equipment to remove and dispose of all surface and ground water entering excavations, trenches, or other parts of the work. Each excavation shall be kept dry during subgrade preparation and continually thereafter until the pipe to be installed therein is completed to the extent that no damage from hydrostatic pressure, flotation, or other cause will result.

All excavations for trenches which extend down to or below ground water shall be dewatered by lowering and keeping the ground water level beneath such excavations twelve inches (12") or more below the bottom of the excavation.

Surface water shall be diverted or otherwise prevented from entering excavated areas or trenches to the greatest extent practicable without causing damage to adjacent property.

The contractor will be held responsible for the condition of any pipe or conduit which he may use for drainage purposes, and all such pipes or conduits shall be left clean and free of sediment.

- 6006 SHEETING AND SHORING. Except where banks are cut back on a stable slope, excavation for structures and trenches shall be properly and substantially sheeted, braced, and shored, as necessary, to prevent caving or sliding, to provide protection for workmen and the work, and to provide protection for existing structures and facilities. Sheet piling, bracing, and shoring shall be designed and built to withstand all loads that might be caused by earth movement or pressure and shall be rigid, maintaining shape and position under all circumstances.

Trench sheet piling shall not be pulled before backfilling unless the pipe strength is sufficient, in the opinion of the engineer, to carry trench loads based on trench width to the back of sheet piling; nor shall sheet piling be pulled after backfilling. When ordered by the engineer, sheet piling shall be

left permanently in the trench. Payment for such sheeting will be made in accordance with the contract provisions for extra work.

When trench sheeting is left in place, such sheeting shall not be braced against the pipe, but shall be supported in a manner which will preclude concentrated loads or horizontal thrusts on the pipe. Cross braces installed above the pipe to support sheeting may be removed after pipe embedment has been completed.

- 6007 ALIGNMENT AND GRADE. The alignment and grade or elevation of each pipeline shall be maintained as shown on the contract drawings by overhead grade lines parallel to the pipe invert.
- 6008 MINIMUM COVER (Water Mains and Service Lines). Where pipe grades or elevations are not definitely fixed by the contract drawings, trenches shall be excavated to a depth sufficient to provide a minimum depth of backfill covering the top of the pipe of forty-two inches (42"). Greater pipe cover depths may be necessary on vertical curves or to provide necessary clearance beneath existing pipes, conduits, drains, drainage structures, or other obstructions encountered at normal pipe grades. Measurement of pipe cover depth shall be made vertically from the outside top of pipe to finished ground or pavement surface elevation.
- 6009 STABILIZATION. Trench bottoms which become soft, mucky, or otherwise unstable during construction operations shall be stabilized, by and at the expense of the contractor, with one or more layers of crushed rock or other suitable material, where and as necessary to provide a firm and stable base for granular fill pipe foundation material to be placed thereon. Not more than one-half inch (1/2") depth of mud or muck shall be allowed to remain on the stabilized trench bottom when the granular fill pipe foundation material is installed.
- 6010 TRENCH EXCAVATION. The contractor shall not open more trench in advance of pipe laying than is necessary to expedite the work. One block or 400 feet (whichever is the shorter) shall be the maximum length of open trench on any line under construction. The contractor shall backfill all open trench by the end of the day's work, except that which is necessary for inspection or immediate continuation of the following day's work.

Except where tunneling is shown on the drawings, is specified, or is permitted by the engineer, all trench excavations shall be open cut from the surface.

The alignment, depth, and grade of all trenches shall be maintained as shown on the drawings by overhead grade lines parallel to the pipe invert.

All open trenches shall be provided with adequate protective devices.

- 6011 **LIMITING TRENCH WIDTHS.** Trenches shall be excavated to a width which will provide adequate working space and pipe clearances for proper pipe installation, jointing, and embedment. Ledge rock, boulders, and large stones shall be removed to provide a clearance of six inches (6") below and on each side of all pipes. These distances are minimum clear distances which will be permitted between any part of the pipe and appurtenances being laid on any part, projection, or point of such rock, boulder, or stone.

Cutting trench banks on slopes to reduce earth load to prevent sliding and caving will be permitted only in areas where the increased trench width will not interfere with surface features or encroach on right-of-way limits. Slopes shall not extend lower than one foot (1') above the top of the pipe.

Limiting trench widths below an elevation of one foot (1') above the exterior top of the installed pipe shall be not less than fifteen inches (15") nor more than twenty-four inches (24") greater than the nominal outside diameter of the pipe.

- 6012 **UNAUTHORIZED TRENCH WIDTHS.** Where, for any reason, the width of the lower portion of the trench as excavated at any point exceeds the maximum permitted in Section **6011** of these specifications either special pipe embedment, or arch concrete encasement, as required by loading conditions and as determined by the engineer, shall be furnished and installed by and at the expense of the contractor.
- 6013 **MECHANICAL EXCAVATION.** The use of mechanical equipment will not be permitted in locations where its operation would cause damage to trees, buildings, culverts, or other existing property, utilities, or structures above or below ground.

Mechanical equipment used for trench excavation shall be of a type, design, and construction, and shall be so operated, that the rough trench excavation bottom elevation can be controlled, that uniform trench widths and vertical sidewalls are obtained at least from an elevation one foot (1') above the top of the installed pipe to the bottom of the trench, and that trench alignment is such that pipe when accurately laid to specified alignment will be centered in the trench with adequate clearance between the pipe and sidewalls of the trench. Undercutting the trench sidewall to obtain clearance will not be permitted.

If the contractor prefers to undercut the bottom of the trench and bring to grade with 1/2-inch (1/2") crushed rock, he may do so, provided the depth of undercut and backfill with crushed rock shall not exceed four inches (4"). Where crushed rock is used, it shall be placed in the trench, spread uniformly, and graded prior to placing the pipe in the trench.

6014 ARTIFICIAL FOUNDATIONS IN TRENCHES. Whenever so ordered by the engineer, the contractor shall excavate to such depth below grade as the engineer may direct and the trench bottom shall be brought to grade with such material as the engineer may order installed. All concrete or other foundations made necessary by unstable soil shall be installed as directed by the engineer. Compensation for extra excavation, concrete, or other foundations, except where provided by contract unit prices, shall be made in accordance with the contract provisions for extra work.

6015 PIPE BEDDING. The pipe shall be laid in a flat-bottom trench which has been carefully graded and shaped so that the barrel of the pipe will have bearing for its full length. Blocking of the pipe will not be permitted.

Granular embedment material shall be spread and the surface graded to provide a uniform and continuous support beneath the pipe at all points between bell holes or pipe joints. It will be permissible to slightly disturb the finished subgrade surface by withdrawal of pipe slings or other lifting tackle.

After each pipe has been graded, aligned, and placed in final position on the bedding material and shoved home, sufficient pipe embedment material shall be deposited and compacted under and around each side of the pipe and back of the bell or end thereof to hold the pipe in proper position and alignment during subsequent pipe jointing and embedment operations.

Embedment material shall be deposited and compacted uniformly and simultaneously on each side of the pipe to prevent lateral displacement.

A. Water Mains: Granular material shall be used for pipe bedding, haunching, and initial backfill. Bell holes shall be excavated in the bottom and sides of the trench to provide ample working space and ensure proper pipe support. No part of the bell shall be in contact with the trench bottom.

Granular material and compacted soil shall conform to the requirements of Standard Detail 60-1.

B. Sanitary Sewers: Granular material shall be used for pipe bedding and haunching. Granular material is also required for the initial backfill on PVC pipe installations. Compacted soil or granular material may be used for initial backfill of DIP and RCP installations. Continuity of embedment material shall be interrupted by compacted soil around each manhole to impede passage of water through the embedment.

Bell holes shall provide adequate clearance for tools and methods used in installing pipe. No part of any bell or coupling shall be in contact with the trench bottom, trench walls or granular embedment at the time the pipe is jointed.

Bedding, haunching and initial backfill materials shall be free of cinders and corrosive materials.

C. Storm Sewers: Granular material is required for the haunching and initial backfill of all storm sewer installations.

If the pipe is located within four feet of the curb and gutter, granular material shall be used for haunching, initial backfill and final backfill for all storm sewer installations.

6016 PIPE INSTALLATION. All work shall be in accordance with the following standards or as specified herein. Prior to backfill, all pipe installations shall be inspected by an authorized representative of the city. All pipe not inspected prior to installation shall be uncovered and inspected.

Flexible Thermoplastic Pipe; ASTM D2321

Ductile Iron Water Mains; AWWA C600

Polyvinyl Chloride Water Mains, C900

Reinforced Concrete Pipe

Joints for reinforced concrete pipe shall conform to Section 7 of ASTM C361, except that gaskets shall have a circular cross section and shall be confined in a groove in the pipe spigot. Pipe with collars in lieu of integral bells will not be acceptable.

Core holes and handling holes in concrete pipe shall be repaired by cementing a properly-shaped concrete plug in place with epoxy cement or by other methods acceptable to the engineer.

Corrugated Steel Pipe

Corrugated metal storm sewer pipe shall be laid with the separate sections joined firmly together, with the outside laps of the circumferential joints pointed upstream, and with the longitudinal laps on the side.

Lateral displacement of the pipe shall be prevented during embedment operations. Pipe shall not be laid in water, nor under unsuitable weather or trench conditions.

All joint preparation and jointing operations shall comply with the instructions and recommendations of the pipe manufacturer.

Hooks shall not be permitted to contact joint surfaces. Care shall be exercised in handling all pipes to prevent damage to pipe ends. Damaged pipe or pipe damaged in laying shall be replaced by and at the expense of the contractor.

6017 TRENCH BACKFILL. All trench backfill above pipe initial backfill shall conform to the following requirements.

Compacted backfill shall be required for the full depth of the trench above the embedment where beneath structures, street, road, or highway right-of-way, driveways, walks, parking areas, and at all locations shown on the plans or as directed by the engineer during the progress of the work.

The top portion of the backfill beneath established sodded areas shall be finished with at least twelve inches (12") of topsoil corresponding to, or better than, that underlying adjoining sodded areas. Topsoil shall be approved by the engineer prior to placement, and unless otherwise directed, shall be material previously excavated and stockpiled for the purpose during excavating and grading operations. Grades on areas to receive topsoil shall be established and maintained as a part of the grading operations. Immediately prior to dumping and spreading topsoil, the surface shall be loosened by discing or scarifying to a depth of two inches (2") to permit bonding of the topsoil to the underlying surface.

Above the initial backfill, job-excavated material may be used for compacted final backfill when the job-excavated material is finely divided and free from debris, organic material, cinders, or other corrosive material, and stones larger than three inches (3") in the greatest dimension. Refer to Standard Detail 60-1 for trenching details for all conduits (including water, storm sewer, sanitary sewer, etc.) in unpaved areas.

For trenching for all conduits under streets (existing and proposed), compacted CA-5 shall be placed from the bottom of the trench to bottom of asphalt pavement. If cover over the pipe or conduit is less than 2 feet from ground surface, CA-5 shall be placed in the bottom of the trench to 6 inches above the top of pipe, overlain by removable flowable fill to the bottom of asphalt pavement from 4' back of curb to 4' back of curb. Refer to Standard Detail 60-3 for details on trenching of conduits under future streets. Flowable fill specifications are provided in Section 6018. For trenching under existing pavement, refer to Section 7000 and Standard Detail 70-1.

Gravel for compacted backfill, other than for street crossings, shall be CA-5 or conform to the following gradation:

Sieve Size	Percent Passing by Weight
1 inch	100
3/4 inch	85 - 100
3/8 inch	50 - 80
No. 4	35 - 60
No. 40	15 - 30
No. 200	5 - 10

The gravel mixture shall contain no clay lumps or organic matter. The fraction passing the No. 4 sieve shall have a liquid limit not greater than 25 and a plasticity index not greater than 5. The backfill shall be compacted by a suitable vibratory roller or platform vibrator to not less than 70 percent (70%) relative density as determined by ASTM D2049.

The method of compaction and the equipment used shall be appropriate for the material to be compacted and shall not transmit damaging shocks to the pipe.

The combination of the thickness of the layer, the method of compaction and the type of compaction equipment used shall be at the discretion of the contractor subject to obtaining the densities as specified above.

Backfill shall not be placed when material contains frost, is frozen, or a blanket of snow prevents proper compaction. Backfill shall not contain waste material, organic material, or debris of any kind.

Trench backfill above pipe embedment in locations other than those specified shall be compacted to 90 percent (90%) of maximum density at optimum moisture content as determined by ASTM D698, unless otherwise permitted by the city engineer.

Uncompacted earth backfill material to be placed above embedments shall be free of brush, roots more than two inches (2") in diameter, debris, cinders, or other corrosive material, and junk, but may contain rubble and detritus from rock excavation, stones, and boulders in certain portions of the trench depth. Uncompacted backfill material above embedments may be placed by any method acceptable to the engineer which will not impose excessive concentrated or unbalanced loads, shock, or impact on and which will not result in displacement of installed pipe. Uncompacted backfill shall be placed to the extent necessary to prevent excessive future settlement.

Compact masses of stiff clay or other consolidated material more than one (1) cubic foot in volume shall not be permitted to fall more than five feet (5') into the trench unless cushioned by at least two feet (2') of loose backfill above pipe embedment.

No uncompacted trench backfill material containing rocks, or rock excavation detritus, shall be placed in the upper eighteen inches (18") of the trench except with specific permission of the engineer, nor shall any stone larger than eight inches (8") in its greatest dimension be placed within three feet (3') of the top of pipe. Large stones may be placed in the remainder of the trench backfill only if well separated and so arranged that no interference with backfill settlement will result.

- 6018 FLOWABLE FILL. No material shall be used until it has been checked or tested for compliance with these specifications and approved by the engineer. Representative samples of all materials proposed for use under these specifications shall be submitted to a private laboratory by the contractor, at the contractor's expense, for testing and preparation of trial mixes to determine the mix design. All tests necessary for determining conformance with the requirements specified herein shall be at the contractor's expense.

Laboratory test specimen(s) of the slurry mix, combined in proportions of the job mix design, shall be prepared and tested and shall meet the following requirements:

Removable:

28-day Compressive Strength 200 psi (1400 kPa) (maximum)

Final Set, ASTM C266 2 hrs. (maximum)

Mix Design (+/-):

Cement.....144 lbs.

Water.....396 lbs.

Sand.....2698 lbs.

A/E.....13%

At the time of delivery, the slurry shall not be less than 60 degrees F (16 degrees C) nor more than 80 degrees F (27 degrees C).

Slurry shall not be placed on frozen material nor be used to displace water. It shall be placed to fill the voids and to the grades shown on the plans or as directed by the engineer. It shall not be used to displace or replace pavement materials.

- 6019 STRUCTURE BACKFILL. Backfill around structures shall be compacted to the extent necessary to prevent future settlement by tamping or other means acceptable to the engineer.

Material for backfill shall be composed of earth only and shall contain no wood, grass, roots, broken concrete, stones, trash, or debris of any kind. No tamped or otherwise mechanically-compacted backfill shall be deposited or compacted in water.

- 6020 DENSITY TESTING. At the option of the engineer, in-place field density testing to determine compliance with specified compaction requirements may be performed using a nuclear moisture-density measuring device. If, as a result of this field testing, the engineer determines that further compaction is required, the contractor shall revise his compaction procedures to obtain the results specified.

- 6021 TUNNEL AND CASING PIPE INSTALLATION. Pipelines shall be constructed in tunnels of the type designated on the drawings, in conformity with the requirements which follow. **Casing pipe will have the strength and integrity equal to or greater than the carrier pipe. Installation will comply with all applicable federal, state, or regulations.** Before starting work on any tunnel, complete details of the method of operation and liner to be used shall be submitted to the engineer for review.

Smooth wall casing pipe shall be welded-steel construction and shall be new material with a minimum yield point of 35,000 psi. Minimum casing wall thickness shall be as indicated in the following table.

Nominal Wall Thickness (Inches)

Diameter of Casing (Inches)	Under Railroads (AREA-Part 5)	All Other Uses
Less than 14	0.188	0.188
14	0.219	0.188
16	0.219	0.250
18	0.250	0.250
20	0.281	0.250
22	0.312	0.250
24	0.344	0.281
26	0.375	0.281
28	0.406	0.312
30	0.406	0.312
32	0.438	0.312
34	0.469	0.312
36	0.469	0.344
38	0.500	0.344
40	0.500	0.344
42	0.500	0.344
44	0.560	0.375
46	0.560	0.375
48	0.560	0.375
50	0.625	0.406
52	0.625	0.406

The conduit shall be installed by jacking into place. Earth displaced by the conduit shall be removed through the interior of the conduit by hand, by auger, or by other acceptable means. Sections of the casing pipe shall be welded together to form a continuous conduit capable of resisting all stresses, including jacking stresses. The casing pipe conduit in its final position shall be straight and true in alignment and grade, as required by the drawings. There shall be no space between the earth and the outside of the casing. Any voids which do occur shall be filled by pressure grouting.

Wood skids shall be provided as shown on the drawings. The wood shall be pressure treated with creosote, pentachlorophenol, or salt-type preservative in accordance with AWWA C2. Cut surfaces shall be given two (2) heavy brush coats of the same preservative. The wood skids shall be securely strapped to the pipe with steel straps.

In sanitary sewer construction, after installation of the pipe in the tunnel, the entire annular space between the pipe and the tunnel walls shall be filled with stabilized sand. Stabilized sand shall be mixed in the proportions of at least 282 pounds of portland cement to each cubic yard

of sand. Cement and sand (fine aggregate) shall be as specified for cast-in-place concrete. Stabilized sand shall be thoroughly mixed in a mechanical mixer. Stabilized sand shall be blown into casing so that all space is filled.

Both ends of casing conduit shall be closed with common brick and mortar.

No interruption of traffic will be permitted at any location where tunnels are required.

6022 DRAINAGE MAINTENANCE. Trenches across roadways, driveways, walks, or other trafficways adjacent to drainage ditches or water courses shall not be backfilled prior to completion of backfilling the trench on the upstream side of the trafficway, to prevent impounding water after the pipe has been laid. Bridges and other temporary structures required to maintain traffic across such unfilled trenches shall be constructed and maintained by the contractor. Backfilling shall be done so that water will not accumulate in unfilled or partially-filled trenches. All material deposited in roadway ditches or other water courses crossed by the line of trench shall be removed immediately after backfilling is completed and the original section, grades, and contours of ditches or water courses shall be restored. Surface drainage shall not be obstructed longer than necessary.

6023 PROTECTION OF TRENCH BACKFILL IN DRAINAGE COURSES. Where trenches are constructed in ditches or other water courses, backfill shall be protected from surface erosion. When the grade of the ditch exceeds 1 percent (1%), ditch checks shall be installed. Unless otherwise shown on the drawings or directed by the engineer, ditch checks shall be concrete. Ditch checks shall extend not less than two feet (2') below the original ditch or water course bottom for the full bottom width and at least eighteen inches (18") into the side slopes and shall be at least twelve inches (12") thick.

6024 DISPOSAL OF EXCESS EXCAVATED MATERIALS. Except as otherwise permitted, all excess excavated materials shall be disposed of away from the site of work.

Broken concrete and other debris resulting from pavement or sidewalk removal, excavated rock in excess of the amount permitted to be and actually installed in trench backfill, junk, and debris encountered in excavation work and other similar waste materials shall be disposed of away from the site of the work.

Excess earth from excavations located in unimproved property shall be distributed directly over the pipe trench and within the pipeline right-of-way to a maximum depth of six inches (6") above the original ground surface elevation at and across the trench and sloping uniformly. Drag with blade machine, or other suitable tool to a smooth, uniform surface without obstructing drainage at any point. Wasting of excess excavated material in the above manner will not be permitted where the line of trench crosses or is within a railroad, public road, or highway right-of-way. The disposal of waste and excess excavated materials, including hauling, handling, grading, and surfacing shall be a subsidiary obligation of the contractor and no separate payment will be made therefore.

6025 SETTLEMENT. The contractor shall be responsible for all settlement of backfill, fills and embankments which may occur within two (2) years of time after final acceptance of the contract under which the work was performed.

A suitable maintenance bond in an amount approved by the city engineer shall be furnished to the city of Gardner by the contractor guaranteeing the maintenance of the construction under which the contract was performed. Said bond shall remain in effect for the period mentioned above from the date of completion and acceptance of the work by the city.

The contractor shall make, or cause to be made, all repairs or replacements made necessary by settlement within thirty (30) days after notice from the engineer.